

Table of Contents

Executive Summary	xiii
Section 1—Critical Skills Development	1
Laboratory Critical Skills: Training the Next Generation	3
Applied Science Internship Program	4
Computer System Administrator Development Initiative	10
<i>Go Figure! A Celebration of Math</i>	13
Los Alamos Dynamics Summer School	18
Materials Science Technician Training Program	28
New Mexico High School Adventures in Supercomputing Challenge	32
Nuclear Science Education for the 21st Century: Glenn T. Seaborg Summer Fellowship Program	37
Robotics Competition	50
Summer School in the Physical Sciences for Undergraduates	54
Section 2—Student Research and Internships	61
Introduction	63
High School Cooperative Program	65
Undergraduate Research	69
Undergraduate Program	71
College Cooperative Program	74
McDermott Scholars Program	76
Graduate Research	81
Graduate Research Assistant Program	83
National Consortium for Graduate Degrees for Minorities in Engineering and Science, Inc. (GEM Fellowship Program)	85
Hertz Foundation Scholars Program	87
National Physical Science Consortium	91
Oak Ridge Institute of Science and Education	93
South Carolina Universities Research and Education Foundation	95
Section 3—Institutional Student Activities and Initiatives	97
Introduction	99
All-Student Meetings	100
Distinguished Performance Awards	101
Distinguished Students Program	102
Programmatic Improvements	105

Los Alamos National Laboratory

The Students' Association	107
Student Exit Survey Results	109
Student Postings Initiative	110
Student Programs Advisory Committee	115
Symposium 2002: <i>Championing Scientific Careers</i>	116
Section 4—Northern New Mexico Math and Science Academy	119
Section 5—K-16 Partnerships in Science, Engineering, and Technology	135
Introduction	137
The Electromechanical Technology Program.....	138
2002 Expanding Your Horizons in Science and Mathematics Los Alamos Conference	141
Fuel Cell Video Documentary	146
Los Alamos Educational Equipment Program	149
Los Alamos Space Science Outreach Program	152
Section 6—Demographic Data on Participants	157

List of Figures

Figure 1. Student Emma Torbert (Princeton) shows off a 3D probe drive she helped conceive, design and build for RSX	5
Figure 2. Cameron Bass (MIT) shows pieces of his optical fiber-optic detector array for FRX-1	5
Figure 3. Student Christopher Cary at RSX shows off the preamplifier he developed	5
Figure 4. More than 40 students came to this well-attended P-24 summer school session	6
Figure 5. A student-built trebuchet siege engine for launching watermelons	7
Figure 6. Tay Naish, a CSADI student in CCN-2	10
Figure 7. Sal Sena, a CSADI student in CCN-2	11
Figure 8. Nick Miller, a CSADI student in CCN-2.....	11
Figure 9. Crystal Salazar, a CSADI student in CCN-2	12
Figure 10. Tennis racket testing	19
Figure 11. Suspended plate	19
Figure 12. Cantilevered beam	20
Figure 13. Test structure for random variation study	20
Figure 14. Spring-mass system	21
Figure 15. A student using a multichannel data acquisition system	21
Figure 16. Students surveying the types of materials that they will be testing at the Structure/ Property Relations Group (MST-8) mechanical testing laboratory	28
Figure 17. A student uses ping-pong balls to create models of crystal lattices	29
Figure 18. Students gather around specialized equipment in a classroom at UNM-LA	30
Figure 19. Brian Rosen, Robert Cordwell, and Stephen Schum at the 12th annual New Mexico High School Adventures in Science Supercomputing Challenge.....	32
Figure 20. Ethnicity of Challenge students	33
Figure 21. View of the ASCI Bluemountain Supercomputer	34
Figure 22. Judges after dinner and a long night of discussing and deciding who would receive what rewards	34
Figure 23.The 2001–2002 finalists on stage during the awards ceremony	35
Figure 24. Summer Teacher Institute logo	35
Figure 25. Teachers' pretest/posttest scores chart	35
Figure 26. Patricia Melfi of UT-Austin transfers Np(VI) with her mentors	40
Figure 27. $\text{Am}(\text{IO}_3)_3$ single crystals.....	41
Figure 28. Coordination polyhedra in $\text{Am}(\text{IO}_3)_3$	41
Figure 29. Experimental setup for the instrumented burn tube	41
Figure 30. Fiber-optic light traces	41
Figure 31. Images obtained from the instrumented tube experiment	42
Figure 32. The chemical structure of DHT	43
Figure 33. The enhanced blast effect of DHT with MIC in a two-liter vessel	43
Figure 34. SEM image of an intermixed composite of aluminum with tungsten trioxide	44
Figure 35. Thermal ellipsoid diagram for $\text{Er}(\pi\text{-1,3-(SiMe}_3)_2\text{-C}_3\text{H}_3)_3$	45
Figure 36. UV-vis absorbance of U(VI) in 3 M TMAOH and after addition of phosphate	45
Figure 37. A view of the packing in the two-dimensional network of $\text{K}(\text{UO}_2)_2(\text{C}_2\text{O}_4)_2\text{OH}\bullet4\text{H}_2\text{O}$	45
Figure 38. A samarium anilido complex	46

Figure 39. A ball and stick representation of [NpO ₃ 2(isoamethyrin)]	47
Figure 40. UV-vis spectra of the grandphyrin, before and after binding by Pu(VI)	47
Figure 41. A thermal ellipsoid of a perfluorinated diimine ligand	48
Figure 42. The angular wave function of f-orbitals possibly involved in the covalent bonding of actinide complexes	48
Figure 43. Students and mentors from the Nuclear Science Education Program	49
Figure 44. Joe Vigil, Program Coordinator, with Robotics student Eric Kutz from Santa Fe	50
Figure 45. Two students working on their robot at te annual BEAM Robotics competition.....	52
Figure 46. Student Activities, 2002	59
Figure 47. FY02 ethnicity and gender of high school cooperative students	68
Figure 48. FY02 ethnicity and gender of UGS students	73
Figure 49. The five McDermott Scholars who interned at the Laboratory in Summer 2002	76
Figure 50. Group of McDermott students visiting the Laboratory	77
Figure 51. Alina Deshpande, a Laboratory employee for almost 9 years.....	83
Figure 52. Laboratory Associate Director for Administration, Richard Marquez, presenting awards	84
Figure 53. FY02 ethnicity and gender of GRA students	84
Figure 54. Hertz Scholars during a demonstration at the Reconfigurable Advanced Visualization Environment Facility at TA-3	89
Figure 55. Heather Alexander labeling a sample of black bear scat for DNA analysis	94
Figure 56. Laboratory Director John Browne answers questions at his annual summer meeting with students	100
Figure 57. Laboratory Director John Browne congratulates Gabriela Sanchez	101
Figure 58. Mabel Grey-Vigil receives congratulations for her Distinguished Mentor Award	101
Figure 59. Dave Modl explains to students how stereo visuals work	103
Figure 60. Students and mentors enjoy breakfast burritos and conversation at a student breakfast held in May 2002	107
Figure 61. Laboratory students gather at the annual student picnic	107
Figure 62. Cameron Bass (MIT) achieved flight at a student picnic	108
Figure 63. Nathaniel Morgan and his wife talk with Symposium 2002 keynote speaker Calvin Mackie	116
Figure 64. James Kovach explains his research on ligand design strategies in organometallic chemistry	117
Figure 65. The program framework	122
Figure 66. Reina Pacheco demonstrates “Volume”	124
Figure 67. Diagram charting “the change process”	125
Figure 68. Boys gather macroinvertebrates in the Rio Grande	131
Figure 69. These children are learning about the bosque	131
Figure 70. A sack lunch at the Oñate Center capped a wonderful field trip	131
Figure 71. The mobile laptop laboratory in Mora	132
Figure 72. Teachers use laptops durng the MSA Summer Institute	132
Figure 73. The Española school superintendent visits classrooms with other NNMCEE participants	133
Figure 74. David Lujan displays a barium fluoride crystal	140
Figure 75. Team 8, “The Beautiful Boats,” tested their model boat with pennies	142
Figure 76. Students have a hands-on experience in the “Fun Properties of Fluids” workshop	143
Figure 77. Presenter and students time themselves pushing a 100-year-old bike	143
Figure 78. Marielle Remillard assembles a motor-control circuit	143
Figure 79. EYH morning workshop evaluation for content	144
Figure 80. EYH afternoon workshop evaluation for content	144

Figure 81. EYH 2002 ethnicity	144
Figure 82. EYH attendance by grade	144
Figure 83. Renewable regenerative fuel cell that uses solar energy to produce power	146
Figure 84. Dr. Michelle Thomsen (NIS-1) discussing analysis of solar data	153
Figure 85. Fifth-grade students studying the magnetosphere and auroras	156
Figure 86. LASSO teachers analyzing solar data	156
Figure 87. FY02 gender and ethnicity for precollege student participants	163
Figure 88. FY02 gender and ethnicity for undergraduate student participants	164
Figure 89. FY02 gender and ethnicity for graduate student participants	165
Figure 90. FY02 gender and ethnicity for faculty participants	166
Figure 91. FY02 student appointment and gender distribution	169
Figure 92. FY02 UGS and GRA five-year conversions	170
Figure 93. FY02 four-year trend	170
Figure 94. FY02 undergraduate student new hires	171
Figure 95. FY02 graduate student new hires	171
Figure 96. FY02 ethnicity and series for high school, UGS, and GRA students	172
Figure 97. FY02 gender for high school, UGS, and GRA students	172
Figure 98. FY02 ethnicity for high school, UGS, and GRA students	173
Figure 99. FY02 ethnicity for high school, UGS, and GRA students	173
Figure 100. Undergraduate students converted to staff positions, 2000–2002	174
Figure 101. Graduate students converted to staff positions, 2000–2002	174
Figure 102. Number of students, 1998–2002	175

List of Tables

Table 1.	FY02 Milestones	5
Table 2.	List of Students in 2002	8
Table 3.	List of FY02 Mentors	9
Table 4.	FY02 Milestones	15
Table 5.	Companies Donating Software for the Duration of the LADSS	21
Table 6.	Distinguished Lecturers	22
Table 7.	Titles and Presenters of Multilecture Tutorials	23
Table 8.	Additional Instruction Received by the Students	23
Table 9.	Summary of Mentors	24
Table 10.	Summary of Assessment Results of the Overall Program	24
Table 11.	Milestones for 2002	51
Table 12.	LASS Mentors and Students 2002	56
Table 13.	Lecturers and Titles	58
Table 14.	LASS Class 2002	59
Table 15.	FY 02 Milestones	72
Table 16.	Majors Represented by the McDermott Scholars at LANL in FY02	77
Table 17.	Students' Suggestions for Summer 2003	78
Table 18.	Schools Attended by This Year's Hertz Foundation Scholars	87
Table 19.	Profile of Undergraduate Majors	88
Table 20.	Ethnicity of Fellows Sponsored by LANL Since 1989	92
Table 21.	FY02 Participant Demographics	92
Table 22.	Student Exit Survey Summary of Results	109
Table 23.	Performance Goals	111
Table 24.	Year 2 MSA Teacher Demographic Information	123
Table 25.	Chart of the Development of MSA Teachers in School Years 2000–2001, 2001–2002, and 2002–2003	125
Table 26.	MSA Effectiveness (SD = Standard Deviation)	126
Table 27.	Indicators/Data Source Matrix	128
Table 28.	School A MSA CTBS/NCE Scores	129
Table 29.	School B MSA CTBS/NCE Scores	129
Table 30.	School C MSA CTBS/NCE Scores	129
Table 31.	School D MSA CTBS/NCE Scores	130
Table 32.	Milestones for FY02	138
Table 33.	Ethnicity/Gender Breakdown of Participants in FY02	138
Table 34.	Breakdown of Equipment and Acquired Cost for New Mexico Schools in FY02	149
Table 35.	Breakdown of Equipment and Acquired Cost for Out-of-State Schools in FY02	150
Table 36.	Demographics	151
Table 37.	Milestones	154
Table 38.	Precollege Student Participants	161
Table 39.	Undergraduate Student Participants	161
Table 40.	Graduate Student Participants	162
Table 41.	Faculty Participants	162

Table 42. FY02 Participant Data—High School Co-Op	176
Table 43. FY02 Participant Data—Undergraduate	176
Table 44. FY02 Participant Data—Graduate	177

Executive Summary

“Students form an important part of the Laboratory culture. They shape the way the Laboratory will operate in the next 20 years.”—John Browne

This report contains a summary of progress in the Critical Skills Development and Student Pipeline Program at Los Alamos National Laboratory (the Laboratory). Focusing on the Laboratory’s mission to “serve the nation by applying the best science and technology to make the world a better and safer place,” we made significant and unique contributions toward building the future technical workforce.

During the year, more than 2,000 students and faculty members participated in research and learning activities in the fields of mathematics, science, engineering, and technology. All students had daily access to staff members and mentors and had an opportunity to present their work at the Student and Postdoctoral Symposium.

Mathematics program activities ranged from identifying latent talent in young people to modeling complex transportation systems. Student science activities included conducting experiments “at the bench,” using supercomputers, and even completing a doctoral thesis. Engineering student activities were focused on multidisciplinary research in teams and extensive work on written and oral communication skills. The Laboratory also provided student access to some of the most advanced technology in the nation.

The Critical Skills Development and Student Pipeline Program applies the scientific and technical resources of the Laboratory to critical needs in workforce development and education. Our goals are to carry out the following tasks:

- Identify, develop, and inspire future scientific leaders;
- Increase the diversity of the Laboratory student pipeline;

- Ensure a highly trained, diverse workforce;
- Facilitate systemic change in mathematics and science education; and
- Serve as a national model to improve the quality of science, mathematics, engineering, and technology education.

The Office of Defense Programs of the National Nuclear Security Administration, Department of Energy (DOE), is the primary funding agency for these student programs. Additional funding is provided by other DOE offices, the National Science Foundation, the New Mexico Department of Education, the Commission on Higher Education, the National Aeronautics and Space Administration, and other sources.

Section 1 of this report covers Critical Skills Development projects supported jointly by the DOE Office of University Partnerships and by Laboratory management. These projects are intended to bring students to the Laboratory, to provide ongoing opportunities for the most talented candidates, and to replenish the Laboratory technical workforce. One new initiative in 2001–2002 was the Applied Science Internship program, which covered areas such as the physics and engineering of lasers, pulsed power, accelerators, inertial confinement fusion, and high-energy density physics. Ongoing initiatives focused students on mathematics, advanced computer systems and administration, materials science, engineering, nuclear science, physics, and robotics.

Section 2 provides a description of internship and cooperative opportunities for high school, undergraduate, and graduate students. In partnership with university faculty members, students in these

Los Alamos National Laboratory

programs receive exposure to a variety of technical, business, and administrative career fields at the Laboratory.

In Section 3, we outline institutional work such as all-student meetings, distinguished-student program and performance awards, programmatic improvements, student postings, the Student and Postdoctoral Symposium, the Student Programs Advisory Committee, and student exit survey results. One part of the survey concluded that about 74 percent of students' experiences at the Laboratory influenced their career plans and goals. A total of 97 percent of the students said that co-workers and managers took the practice of safety seriously.

The impact of the Northern New Mexico Math and Science Academy is summarized in Section 4. Impact is measured by observing teacher practices, collaboration to deliver cross-curricular units, and use of data and technology, and by analyzing

student work and graphic organizers, articulation of performance standards and benchmarks, and student grades and scores on achievement tests.

Section 5 covers precollege through graduate school partnerships in science, engineering, and technology. The security of the nation depends upon increasing collaborations and the awareness and understanding of the importance of scientific endeavor. Our successful partnerships serve as national models to improve achievement in mathematics and science.

The report concludes with Section 6, demographic data about the participants in the programs summarized in Sections 1 through 5.

The Critical Skills Development and Student Pipeline Program at Los Alamos is highly valuable to the Laboratory, DOE, and the nation. We are very proud of the accomplishments recorded here and look forward with enthusiasm to our future work.